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PHYSICS.—*A direct-reading device for use in computing characteristics of vacuum tungsten lamps.*[1] J. F. SKOGLAND, Bureau of Standards.

It has been shown in a previous paper[2] that the ordinary characteristic relations of vacuum tungsten lamps can be expressed with high precision by a set of characteristic equations, each involving two variables; or solutions can be made more quickly by employing tables computed from the equations. For example, having given observed values of voltage, candle-power, and watts per candle, the values of Cp and wpc at any other voltage are obtained from the equations or tables as follows:

1. From the observed values of voltage and Cp their normal values, that is, their values at normal wpc (1.20), are computed.

2. The ratio of the desired voltage to the normal voltage just found is computed.

3. Substitution of this voltage ratio in the proper equations, or reference to the corresponding point in the tables, gives a Cp factor and the actual wpc.

4. The normal Cp is multiplied by the Cp factor to obtain the desired Cp.

[1] Communicated by the Bureau. To appear in full as a Scientific Paper of the Bureau of Standards.

[2] Middlekauff and Skogland, Characteristic equations of tungsten filament lamps and their application in heterochromatic photometry, Journ. Wash. Acad. Sci. **5**: 61. 1915; Bureau of Standards Scientific Paper No. 235.

This process though simple, requires considerable time before a solution is obtained. The direct reading device here described and presented ready for use solves directly and without preliminary reduction all problems introducing as variables the voltage, candlepower, and wpc of vacuum tungsten lamps. Its construction depends directly upon the characteristic equations mentioned above.

This device consists of volt, watts per candle, and per cent candlepower scales. The wpc and per cent Cp scales are fixed in their relation to each other. The volt scale is arranged to be detached from the plate, so that it may be applied to the fixed scales at the point corresponding to observed values of wpc and voltage. From a single setting of the volt scale to observed values within the range of from 0.70 to 2.05 wpc can be read values of any one of the variables at any other point within this range. The volt scale has a range of from 94 to 166 volts. The chosen limits of wpc and voltage are considered sufficient to include settings and solutions for 105–130 volt lamps in standardizing and life test-work.

A test of the device, illustrated in part by examples, indicates that, on an average, values of per cent Cp and of wpc read therefrom deviate from those obtained by use of Tables 20 and 22 of the paper just referred to by amounts not exceeding 0.10 per cent and 0.05 per cent respectively; also that values read from the scales agree with observed values nearly as closely as those computed by use of the tables. All of the points (referred to horizontal and vertical scales of equal parts) through which lines of the scales of this device were drawn have been tabulated, so that similar scales of the same or different range can be constructed directly from these values. Sufficient discussion of the derivation of these values and of the relative position of the scales has been given to direct the construction of scales not included within the wpc range here employed. By the general method of this paper any related functions of exponential form and of the same degree as the characteristic equations can be represented and used as scales of a similar device.

The chief merits of the device when compared with other methods of characteristic evaluation seem to be its simplicity and precision, and the saving of time resulting from its use. Solutions are made directly, without reference to normal wpc, voltage ratios, exponents, etc. These considerations should recommend it to testing and standardizing laboratories.

PHYSICS.—*The effective resistance and inductance of iron and bimetallic wires.*[1] JOHN M. MILLER, Bureau of Standards.

When a current of electricity flows through an iron wire, the lines of magnetic force and the resulting magnetization of the iron are circular. From measurements of the self-inductance of the wire with direct current an exact permeability curve for circular magnetization can be obtained. As ordinarily measured, the permeability for axial magnetization is obtained. A comparison of the two kinds of magnetization shows that for some wires the permeability curves are similar, but that for others the circular permeability may be considerably less than the axial. The differences are due probably to lack of homogeneity or isotropy of the iron caused by drawing and by heat treatment.

A method based upon Anderson's modification of the Maxwell bridge for measuring inductances is used to measure the effective resistance and inductance of six samples of iron telegraph and telephone wires and three samples of copper-clad steel, bimetallic wires. The measurements are made at frequencies up to 3000 cycles per second and with currents up to 10 amperes. The results are given by tables and curves. The so-called Steel telephone wires are considerably poorer conductors at low frequencies and low current strengths than the grade called "Extra Best Best," but at higher frequencies and current strength the Steel wires may be better conductors. At the higher frequencies the resistance and inductance of the copper-clad wires become practically independent of the current flowing through the wire.

[1] Detailed paper to appear in the Bulletin of the Bureau of Standards.

From considerations of bimetallic wires as two circuits in parallel, formulas are obtained which permit the computation of effective resistance and inductance of the wires. The core is treated as one circuit and the shell as another; the self inductance of each is computed, as well as the mutual inductance of one on the other. Assuming no skin effect in the shell and introducing the effective resistance and inductance of the core for a given frequency, the resistance and inductance of the whole wire can be computed for that frequency from the expressions for the equivalent resistance and inductance of two circuits in parallel. The measured values of the copper-clad wire for low current strengths are compared with the computed values, and the agreement is very satisfactory. The formulas are also used in computing wire tables for copper-clad steel wire. Values of effective resistance and inductance are tabulated for the even sizes from No. 0 to No. 12 A. W. G. for conductivities of 30, 40, and 50 per cent of hard drawn copper and for frequencies up to 1000 or 3000 cycles per second.

PHYSICS.—*The calculation of the maximum force between two parallel, coaxial, circular currents.*[1] FREDERICK W. GROVER, Bureau of Standards.

The force of attraction or repulsion between two currents flowing in parallel, coaxial, circular paths of unequal radii, increases as the distance between their planes is increased, until a maximum value of the force is reached, and then, as the distance is indefinitely increased, decreases toward zero as a limit.

It was shown by Maxwell that the distance for which the force is a maximum bears a ratio to either of the radii, which is a function of the *ratio of the radii alone*, and depends in no way on their absolute values. Further, the maximum value of the force, with unit current in each circuit, is also a function of the radii alone.

These facts have been utilized in the current balance, first used by Lord Rayleigh, in which is measured the force between

[1] Detailed paper to appear in the Bulletin of the Bureau of Standards

two parallel circular coaxial coils, one fixed, and the other attached to one end of the beam of a balance, the distance between the planes of the coils having been adjusted until the force exerted between the currents in the coils is a maximum. From the observed weights, which must be added to the other arm of the balance to restore equilibrium, the value of the current flowing through the two coils in series may be calculated, provided the ratio of the radii is known. The latter may be determined experimentally by an electrical method, without measuring the individual radii, and with an accuracy not attainable from direct measurements of the dimensions of the coils.

The calculation of the constant of the balance is based on the theory for two circular filaments to which the coils may be regarded as equivalent. The corrections necessary to be taken into account, because of the finite cross section of the coils, have been derived by Rayleigh, Lyle, and others, and reference may be made to the paper on the "Determination of the International Ampere in Absolute Measure," by Rosa, Dorsey, and Miller, for a treatment of this question and for other details concerning the theory and methods of manipulation of the balance.

The force between two parallel, circular coaxial currents of given radii, situated with any desired distance between their planes, may be calculated by the formula of Maxwell in elliptical integrals, or by the formulas of Nagaoka which involve q series.

Previously, the value of the maximum value possible of the force between any two such circular currents, of given radii, has been obtained by calculating the force directly (by means of the formulas just mentioned) for a number of chosen distances of the coils in the neighborhood of the critical distance, which was supposed to have been approximately determined beforehand. The final value of the maximum force was determined by interpolation from this series of calculated values. This process is indirect and laborious.

In the detailed paper to be published a formula is derived for calculating the value of the critical distance from the assumed ratio of the radii. By substituting the distance thus found in

one of the above general formulas for the force, the maximum value of the force can at once be determined. In some cases the maximum force can be calculated directly from a formula given here in which this substitution has been made once for all.

The formula for the critical distance is, unfortunately, not simple enough to allow of the direct calculation of the critical distance from the given ratio of the radii. It is, however, not difficult to obtain the desired value with great accuracy by a method of successive approximation, provided a first approximation is at hand.

The latter part of the paper is devoted to the development of methods for facilitating this process. The formulas derived are fully illustrated by numerical examples, and tables are given of the critical distance and the value of the maximum force for such values of the ratio of the radii as are likely to occur in practice. It is further shown how the constants for coils, whose dimensions differ slightly from one of the exact ratios given in the table, may be derived from the latter values with little trouble and labor.

To test the new formulas the complete calculations of the constants of the coils of the Bureau of Standards current balance have been carried through, and the results were found to be in agreement with the values obtained by the interpolation method within less than a part in a million.

PHYSICS.—*On the construction of primary mercurial resistance standards.*[1] F. A. WOLFF, M. P. SHOEMAKER, and C. A. BRIGGS, Bureau of Standards.

This paper deals with the construction of four one-ohm mercury standards of resistance in accordance with specifications adopted by the International Conference on Electrical Units and Standards (London, 1908). The London Conference defined the international ohm as the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of a constant cross-sectional area and of a length of 106.300 cm.

[1] To be presented in full as a Scientific Paper of the Bureau of Standards.

Because of the impossibility of exact realization of the above conditions, principally because of the impracticability of securing glass tubing of strictly uniform bore, certain specifications were essential. Those adopted specified that the tubes used must be made of a glass the dimensions of which change little with time; that they be well annealed and straight; that the bore be as nearly as possible uniform and circular; that the area of cross-section of the bore be approximately one square millimeter; and that the mercury have a resistance of approximately one ohm. It was also specified that each tube be accurately calibrated, and that no tube have a caliber correction greater than 5 parts in 10,000. The length of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury must all be determined at a temperature as near to 0°C. as possible, all measurements being corrected to 0°C.

The four tubes used at the Bureau were selected from a large number of tubes of Jena 59 III glass, specially drawn by Schott and Genossen, and were straightened, annealed, and graduated by M. Baudin in Paris.

At the Bureau of Standards, they were very carefully calibrated, their caliber factors, ranging from 1.000047 to 1.000096, being determined to an accuracy of about one part in a million. The tubes were cut at points giving a resistance, including the end correction, of approximately one ohm, the cuts being located at points for which the cross-section could be most accurately calculated. The ends were ground and plane polished. The tubes were tapered at the ends to fit into the end bulbs, used in making electrical measurements, and into the glass cleaning and drying fittings.

The Reichsanstalt method was employed for the determination of M_o, the mass of mercury required to just fill a tube at 0°C. A tube was exhausted, filled with mercury and placed vertically within a double walled ice bath, the lower end of the tube being sealed by a plane polished plate, and the upper end, carrying a slight excess of mercury, being protected by a ground glass cap.

The excess of mercury was removed by stroking off with a plane polished glass plate in a gimbal mounting, the conden-

sation of moisture being eliminated by a current of cooled and dried air directed at the end of the tube and at the stroking off plate. Weighings were made in a special balance room, on a Stückrath balance sensitive to a hundredth of a milligram. Six fillings of each tube were made, the mean of the average deviations of the individual fillings from their respective means being but ± 4 parts per million.

The problem of determining L_o, the length of the axis of a tube at 0°C., was reduced, through the use of suitably ruled end pieces of platinum-iridium, from one of comparing end standards to that of comparing line standards. Comparisons were made directly with corresponding known intervals on a nickel-steel meter. The length constant added, due to the end pieces, was determined by abutting the end clips and measuring the interval between the lines on them by comparison with a subdivided decimeter standard. The probable error in the lengths as determined, all things considered, did not exceed five ten-thousandths of a millimeter.

Electrical comparisons of the mercury units were made by the Thomson bridge method, the mercury units and five sealed manganin standards being substituted in turn in the same bridge arm. The ratio coils and the manganin standards were contained in a thermostatically controlled oil bath, while the mercury units were in the ice bath adjoining. Connections from the tubes to the bridge were made by inserting heavy copper conductors in the glass terminal protecting tubes of the end bulbs employed, the tubes being partly filled with mercury.

Seven fillings of each tube for electrical comparison were made in 1911. The international ohm as defined by the four mercury standards was found to be 25.5 millionths smaller than the international ohm as represented by the manganin coils at that time. The average deviation of the four tubes from their mean was but ± 5 parts per million.

A second and third series of electrical comparisons, made in June and December, 1912, showed the mercury standards to have changed with respect to the wire standards. Redeterminations

of M_o, L_o and the calculated R_o were therefore made for each tube, the average change found being 1.1, 9.4 and 8.2 parts per million respectively.

On the basis of the above new determinations the international ohm, as represented by the four mercury standards in December, 1912, was 12.5 millionths smaller than the international ohm as represented by the manganin coils at the same time. England, Germany, Japan, Russia, France, and the United States now have mercury standards of resistance. Comparison of the units defined by the mercury standards of the above countries in 1913 (those of France excepted; dates not being available) indicate a very satisfactory agreement, the average deviation of the units of the several countries from the mean being about ± 7 parts per million.

PHYSICAL CHEMISTRY.—*An investigation of fusible tin boiler plugs.*[1] G. K. BURGESS and P. D. MERICA, Bureau of Standards.

An investigation of fusible tin boiler plugs has been conducted at the Bureau of Standards to determine what are the types of deterioration to which they are subject in service and to what these various types are due. The function of the fusible tin boiler plug is, as its name indicates, to give warning by the melting of the tin plug and blowing out of the boiler overheating. The attention of the Bureau has, however, been directed to several instances of the failure of such plugs so to operate, and examination showed that the tin in these plugs had become oxidized in service to SnO_2, melting above 1600°C.

About 1050 plugs—including used and new plugs—were obtained through the courtesy of the Steamboat-Inspection Service, and were examined as to design and construction, and condition and purity of the tin filling. Of the four classes or types of deterioration noticed in such used plugs, one could be pronounced dangerous, and that consisted in the formation of this

[1] To appear as a Technologic Paper of the Bureau of Standards.

oxide SnO_2, either as a solid mass at the fire end of the plug or as a network throughout the tin filling. It was discovered that this latter form of oxidation in service depended on the presence of zinc in amounts as small as 0.3 per cent. This zinc is insoluble (that is, it does not form a solid solution with tin) in solid tin, and upon long heating at about 180°C. the zinc in such a tin plug coalesces to form a network bounding the tin grains. This zinc is easily corroded by many kinds of boiler water, for instance alkaline waters, and the oxide or corrosion products of this zinc and of the tin afterwards attacked, remain and form a solid, continuous oxide mass which in some cases has held the pressure of the boiler even after the tin remaining had melted. Tin plugs containing zinc were made up and heated in an autoclave with water at from 180° to 195°C. for 500 hours, after which this network structure was seen clearly developed. Plugs of pure tin were unchanged under the same conditions of test.

Lead and zinc were found to be the principal impurities in tin plug fillings, and since all "failed" plugs contained these or other impurities the conclusion is reached that if these impurities are eliminated by strict specifications and inspection, which will allow only admittedly superior qualities of tin such as Banca and some others, the dangers of these plugs will no longer exist.

It was found that a determination of the freezing points of samples of tin by a cooling curve method afforded a very good criterion of the purity of such tin, as approximately 0.1 per cent of either lead or zinc could be detected. This method was developed and is recommended as a quick and convenient method for the inspection of the purity of tin in tin plugs.

Various existing specifications for fusible tin boiler plugs are discussed in the complete paper and the conclusion is reached that tin equal to Banca tin 99.9 per cent pure should be used for such plugs where possible; where such tin can not be obtained it is likely that tin of 99.8 per cent purity including all high grade tin qualities would be satisfactory.

GEOLOGY.—*Nepheline basalt in the Fort Hall Indian Reservation, Idaho.*[1] GEORGE R. MANSFIELD and ESPER S. LARSEN, Geological Survey.

OCCURRENCE[2]

One of the igneous rock samples collected by the United States Geological Survey party in the Fort Hall Indian Reservation, Idaho, in the summer of 1913, proved upon examination in thin sections to be nepheline basalt. Because of the relative rarity of rocks of this type any new occurrence of them is of scientific interest and is worthy of note. Indeed, nepheline-bearing rocks and all the so-called alkali rocks are very rare on the Pacific slope of North America.

The Fort Hall Indian Reservation is in southeast Idaho and may be conveniently reached from either Pocatello or Blackfoot on the Oregon Short Line Railroad. Pocatello lies about 3 miles south of the central part of the reservation and Blackfoot is on the northern border. The locality of the nepheline basalt is in the northeast part of the reservation about 24 miles nearly due east of Blackfoot. The rock forms a little knoll on a ridge that descends northeast along the north side of Wood Creek in the SW.¼ of the SE.¼ sec. 18, T. 3 S., R. 38 W. Boise meridian. The area occupied by the basalt is small and the occurrence would be insignificant were it not for the unusual mineralogical composition of the rock.

The rocks in the immediate vicinity of the basalt are mainly sedimentary rocks of Triassic and possibly Jurassic age that outcrop in bands extending from northwest to southeast and apparently form the west limb of a syncline that is inclined northeast. The eastern limb of the syncline is more or less concealed by Tertiary sediments and volcanic rocks. The sedimentary rocks are somewhat faulted. The knoll on which the basalt occurs lies in the belt of Portneuf limestone, a massive and siliceous limestone that constitutes the upper formation of the Thaynes group (Lower Triassic). About one-third mile to the northeast are massive ledges of the Higham grit, the basal member of the Nug-

[1] Published by permission of the Director of the U. S. Geological Survey.
[2] By Mr. Mansfield.

get sandstone, of Jurassic or Triassic age. Associated with the nepheline basalt and apparently surrounding it is a rhyolitic rock that was not examined closely in the field but may underlie or be penetrated by the basalt. This rock resembled other fine-textured, siliceous, igneous rocks observed elsewhere in the reservation and no sample was collected. The unusual character of the accompanying basalt was not then recognized and the contact of the two rocks was not observed. No fragments of the rhyolitic rock were found in the basalt although some search for them was made. Inclusions, at first mistaken for pieces of the above-mentioned grit, proved to be fragments of a coarse-textured igneous rock.

Other igneous rocks occur in various parts of the reservation but these all, so far as studied, are normal rhyolites, basalts, andesites, and quartz-latites. In general the igneous rocks lie around the borders of the sediments on the north, northeast, and northwest, and compose larger or smaller portions of the lower hills. They occupy some of the valleys and are accompanied in places by large bodies of ash beds and tuffs.

The geology of the igneous rocks has not been worked out in detail and their geologic age has not yet been accurately determined. Present information points to at least four epochs of volcanic activity, extending from perhaps middle Tertiary into the Pleistocene. The order of succession appears to be an early intermediate or basic series of eruptions with andesites and perhaps basalt followed by outpourings of rhyolite. These were in turn followed by olivine basalts in a number of places, well exposed in the canyon of the Blackfoot River. The latest eruptions appear to have been latitic with both flows and clastics, the last forming an extensive sandy area which is in part dune-covered. The place of the nepheline basalt in this succession is not known, but it appears to be extrusive and is very fresh. It probably was not closely connected with the olivine basalts.

PETROGRAPHY[3]

Description. The nepheline basalt is dark greenish gray and is dense except for a few large, rough cavities. In the hand

[3] By Mr. Larsen.

specimen it shows abundant pale yellowish green grains of olivine up to 2 millimeters across and a few small grains of augite in an aphanitic groundmass. It contains a few small inclusions of shaly material and one large inclusion of a nearly white, granular rock made up almost entirely of striated feldspar and quartz.

Microscopic examination shows the rock to be made up largely of pyroxene and olivine with some nepheline, phlogopite, iron ore, and apatite. The texture is porphyritic and the phenocrysts, which average about a millimeter in cross section, and are chiefly forsterite with some diopside, make up about a third of the rock. They are imbedded in a holocrystalline groundmass made up chiefly of rods and grains of diopside which lie in a clear matrix or are poikilitically included in phlogopite. The clear matrix is probably in part nepheline but may contain some glass. The average cross section of the minerals of the groundmass is about 0.01 mm.

The forsterite is in clear grains of the usual form. In cross sections the grains range from over 2 millimeters to a small fraction of a millimeter, but the greater part are not far from a millimeter. They have the following optical properties: $\alpha = 1.641 \pm 0.003$; $\beta = 1.661 \pm 0.003$; $\gamma = 1.680 \pm 0.003$; $2V = 87°$ (computed from the refractive indices); optically +. In convergent light the bars of the interference figure are nearly straight and the dispersion of the optic axes is barely perceptible with $\rho < v$.

In addition to embayments filled with the groundmass the forsterite carries a few inclusions of the iron ore and chains of gas or liquid inclusions. The mineral shows no signs of alteration except for a narrow reddish border which probably represents incipient alteration to iddingsite. A Rosiwal determination on two thin sections showed 24.9 ± 1 per cent by volume or 26.4 per cent by weight of olivine.

The diopside is mostly in the groundmass, but the crystals vary greatly in size and some are a millimeter across. The diopside is nearly colorless but shows a faint greenish cast as compared with the water-clear olivine. A very few of the larger crystals show small cores or narrow zones which are rather deep green and pleochroic. It shows zonal growths with somewhat different extinction angles and a faint hour-glass structure. The

extinction angles are very large; those for the green part are the larger, indicating a higher content in iron.

The nepheline is interstitial to the diopside. It is clear, has an index of refraction near that of Canada balsam, and is indistinctly polarizing. It is commonly without crystal outline but square sections are occasionally present. It is in too small grains for positive identification by optical means alone. Some glass may be present; no feldspar was found.

In elongated streaks or irregular patches the abundant diopside rods are embedded poikilitically in mica, the mica forming less than half of the area. This mica is pleochroic, rather light reddish brown parallel to the cleavage and nearly colorless normal thereto. It is probably phlogopite or a biotite rather poor in iron.

Chemical composition. An analysis of the nepheline basalt, made by W. C. Wheeler in the laboratory of the Geological Survey, is given in column 1 below and is accompanied by the analyses of similar rocks for comparison:

Analyses of nepheline basalt and related rocks.

	1	2	3	4	5
SiO_2	45.17	44.99	48.29	39.47	39.92
Al_2O_3	10.02	5.91	10.00	11.26	8.60
Fe_2O_3	3.55	3.42	2.93	8.74	4.40
FeO	5.03	8.30	5.46	4.98	8.00
MgO	19.84	21.02	17.22	14.33	20.17
CaO	8.57	7.89	11.80	12.08	10.68
Na_2O	3.11	0.91	2.78	5.04	1.91
K_2O	1.61	0.74	0.45	1.86	1.03
H_2O-	0.69	3.82	1.95	0.63	0.43
H_2O+	1.58				1.45
TiO_2	0.54	0.97		1.56	2.70
CO_2	none	trace			
P_2O_5	0.28	0.05		0.99	0.51
S	0.06				trace
Cr_2O_3	0.11	0.25			0.14
NiO		none			0.06
MnO	0.13	trace		trace	0.24
BaO	0.07				0.06
SrO	0.06				0.04
	100.42	99.17	100.88	100.94	100.42*

* Including V_2O_3 0.04, F 0.07, and deducting 0.030 for F.

1. Nepheline basalt (III) IV. 1 (2).$_3$.2. (1) 2 Rossweinose. About 24 miles east of Blackfoot, Idaho.

2. Periodtite, IV.1.'.$_3$.'2.'2, Crystal Falls, Mich. H. N. Stokes, analyst. Described by J. Morgan Clement, Jour. Geol., **6**: 386. 1898.

3. Gabbro, 'IV.1'.'$_3$.2.'2, Etzdorf, Rosswein, Saxony. Sachsse and Becker, N. J., 1893, II, p. 503.

4. Nepheline basalt, 'IV.2.$_3$.2'.'2, Schafberg Plateau, Saxony, J. Stock, Tsch. Min. Pet. Mitt., **9**: 466. 1888.

5. Nepheline basalt, IV.'2.$_3$.2.'2, Black Mt., Uvalde Co., Texas. W. F. Hillebrand, analyst. Described by Whitman Cross, U. S. Geological Survey, Bull. 419, p. 43.

Classification. The great abundance of augite, olivine, and biotite, and the presence of nepheline as the only feldspathic mineral, places the rock as a biotite-bearing nepheline basalt rather high in olivine.

In the Quantitative Classification the norm and the systematic position of the rock are as follows:

Norm and systematic positions of nepheline basalt from about 24 miles east of Blackfoot, Idaho

or	9.45	Class: Sal = 34.91 = 0.554 (III) IV Fem 63.03
ab	5.76	Order: PO = 55.96 = 8.74 1 (2) M 6.40
an	8.62	Section: P = 25.35 = 0.826 3 O 30.61
ne	11.08	Rang: Mg + Fe + K_2O + "Na_2O 568 = CaO =116 4.90 '2
di (MgO: FeO = 12: 1)	25.35	
ol (MgO: FeO = 12: 1)	30.61	Subrang: MgO = 496 = 6.89 (1) 2 FeO 72
il	1.06	
mt	5.34	(III) IV. 1 (2).$_3$.'2. (1) 2, Rossweinose.
ap	0.67	
H_2O, etc.	2.18	
	100.12	

Comparison of the norm and mode. The presence of considerable phlogopite in the norm and the presence of feldspar in the mode and its absence in the norm are the most apparent differences between the two. The following calculation of the mode from the chemical composition and the known mineral composi-

tion is no doubt a close approximation to the actual mineral composition. The composition of the norm is given for comparison.

Mode and norm of nepheline basalt from about 24 miles east of Blackfoot, Idaho

	Mode	Norm	Difference
Apatite	1	1	0
Ilmenite	1	1	0
Magnetite	3	5	2
Biotite	8		−8
Forsterite	26	31	5
Diopside	39	25	−14
Nepheline	20	11	−9
Orthoclase		9	9
Albite		6	6
Anorthite		9	9
H_2O	2	2	0
Total	100	100	

The comparison of the norm and the mode thus indicates that the norm shows more magnetite, forsterite, and feldspar than the mode and less biotite, diopside, and nepheline.

BOTANY.—*Some new caesalpiniaceous trees of Panama.* HENRY PITTIER, Bureau of Plant Industry.

The botanical exploration of the Isthmus of Panama begun under the auspices of the Smithsonian Institution in 1910, and since continued occasionally, has brought to light startling facts with reference to the occurrence of certain genera hitherto unknown within that region. It has been known for a long time that Middle America is mainly a territory of transition between the floras of two continents, in which many genera have their northernmost or southernmost limit, the proportion of either South American or North American species respectively decreasing or increasing according to the distance from their centers of dispersion. But there was no indication whatever of the very sudden change which takes place in Darien, the eastern part of Panama and the connecting link with South America.

This abrupt transition brings in as new elements of the flora several genera known heretofore as represented exclusively in the Amazonian Hylea or in the eastern part of South America. The presence of these species in a district separated from regions of identical climatic conditions both by imposing mountain ranges and the semixerophytic belt of Colombia and Venezuela constitutes a most interesting problem, the solution of which may not be reached until the interlocking slopes and valleys of Colombia and Venezuela have been thoroughly explored. Among such Panamanian representatives of Brazilian genera one species each of Stachyarrhena, Cassupa, Browneopsis, and Coligonia has already been detected, while many others are certain to appear during the further progress of the work of identifying and naming the extensive collections now at hand. In the present paper, 3 more species, belonging to 2 genera, are described under the names *Peltogyne purpurea*, *Centrolobium yavizanum*, and *Centrolobium patinense*. Furthermore, an undescribed species of Dilodendron has been collected in the hilly region of the Chucunaque Valley, while the forests of Darien in general have furnished an unusually strong contingent of Lecythidaceae, among them 1 species of Couroupita, 4 of Lecythis, 3 of Eschweilera, and 2 of Gustavia.

Another interesting fact never brought out before is the considerable development, along the Pacific coast, of the mangrove formation, and the presence in the inner part of the tidal-belt of a characteristic tree allied to the *mora* of Guiana and never described. Besides being of importance as an ecologic element, this species enjoys the peculiarity of possessing the largest known dicotyledonous seed. It also is described below under the name *Dimorphandra megistosperma*.

Centrolobium yavizanum Pittier, sp. nov., ramulis juvenibus foliisque pube molli ferruginea evanescente dense vestitis, petiolis communibus teretibus, longitudinaliter striatis, stipulis ovatis, obtusis, extus dense villoso-lanatis, intus pubescentibus, foliolis membranaceis, breviter petiolulatis, ovatis vel elliptico-lanceolatis, argute acuminatis, basi rotundatis, leviter emarginatis, supra glabrescentibus, infra glabratis, ad costas venasque rufo-villosis; floribus . . . . ; legumine primum glanduloso-tomentello dein glabrato, aculeis partis seminiferae

densis, acicularibus, stili vestigio adscendente, apice recurvato, ala cultriformi, apice rotundata, venis a basi alae adscendentibus, demum a latere stilifero arcuatis.

Arbor decidua, 25–30 metralis, cortice griseo, coma elongata. Petiolus communis 30–50 cm. longus, e basi attenuatus; petioluli circa 3 mm. longi, folioli 13–17, 6.5–12 cm. longi, 4–5.5 cm. lati, jugis inferioribus latioribus brevioribusve, intermediis longioribus. Pedicelli floriferi 7–8 mm. longi, puberuli, bracteolis angustis, 3 mm. longis, persistentibus; calyx glandulosus, ferreo-puberulus, persistens, lobulis obtusis; ovarium stipitatum. Pedicellus fructifer 1 cm. longus, calycem incrassatum sustinens; legumen cum ala 12–14 cm. longum, 4–5 cm. latum, e stipite 2 cm. longo aculeato suffultum, aculeis circa 1.8 cm. longis.

Type in U. S. National Herbarium, no. 716,636.

PANAMA: In virgin forest between Pinogana and Yaviza, southern Darien, leaves and fruits only, April 22, 1914 (*Pittier* 6572, type).

Centrolobium patinense Pittier, sp. nov., ramulis juvenibus petiolisque pube molli fulva vel obscure purpurea dense vestitis, petiolis communibus teretibus, longitudinaliter striatis, stipulis late ovatis, subobtusis, lanatis, foliolis membranaceis, breviter petiolulatis, ovatis, abrupte acuminatis, basi rotundatis nunc emarginatis, ad costas venasque sparse rufo-villosulis, supra pubescentibus, infra glabratis, floribus . . . . .; legumine juveni glanduloso, rufo-tomentello, demum glabrato, aculeis partis seminiferae densis, acicularibus, stili vestigio adscendente, recto, ala flabelliformi, apice oblique truncata, venis a basi alae adscendentibus dein a latere stilifero arcuatis.

Arbor decidua, 30 m. et ultra alta, cortice griseo, ligno duro, rubrospadiceo, coma elongata. Petiolus communis 30–35 cm. longus; folioli 11–15, 3–12 cm. longi, 2.5–7 cm. lati, jugis intermediis majoribus; petioluli 4 mm. longi. Pedicellus fructifer 1.5 cm. longus; calyx persistens, incrassatus; stipes dense rufo-hirsutus, aculeatus, 1.4 cm. longus; legumen cum ala 17–20 cm. longum, 6–8 cm. latum, aculeis usque ad 3 cm. longis.

Type in U. S. National Herbarium, no. 716,677.

PANAMA: Forest on dry hills at Punta Patiño, southern Darien, leaves and fruits only, June, 1914 (*Pittier* 6611, type).

These two species of a genus hitherto considered as exclusively Brazilian were one of the surprises of my last expedition to Darien. Besides having the characteristically shaped fruit of Centrolobium, they show minor details as to the numerous minute, resinous glands covering the leaves, young shoots, parts of the inflorescence, and the fruits in their first stage of maturity. In shape the fruit of *C. yavizanum* reminds one of that of *C. robustum* Mart., but in size it comes between the two varieties of this latter species and its veins are more strongly arcuate than in either of the two.

In size the fruit of *C. patinense* equals and even surpasses that of *C. robustum macrochaete*, but the form of the wing is quite distinct, its apex being cut in a distinct line almost parallel to the opposite margin. From the other Brazilian species the difference is greater still, so that there can be no doubt as to these Panamanian forms being specifically distinct.

Centrolobium yavizanum and *C. patinense* differ from each other in their leaflets, these more numerous on the average, more elongated, and emarginate at the base in the former, less numerous, shorter and broader, and simply rounded at the base in the latter. The petiolules also are sensibly shorter in the first species, which has comparatively smaller fruits, the wing rounded at the tip like a table knife, and not obliquely truncate as in the latter. The flowers of both species are unknown, the few details included in the description of *C. yavizanum* having been obtained from remnants collected along with the fruits.

Centrolobium patinense is known among the natives of Panama under the name of *amarillo de Guayaquil*, and is reputed as a cabinet wood on account of its hard, fine-grained wood, beautifully veined in several shades of red.

Peltogyne purpurea Pittier, sp. nov., ramis teretibus cortice grisea, ramulis gracilibus, violaceis; foliis deciduis, glaberrimis, stipulis semiovatis, acuminatis, membranaceis, caducissimis; foliolis unijugis, breve petiolulatis, falcatis, acuminatis, inaequilateralibus, basi oblique rotundatis, stipellis filiformibus, caducissimis; inflorescentia racemosa, pauciflora, floribus . . . . .; legumine 1-spermo, pedicellato, semiorbiculato, glaberrimo, suturis angustissimis, laevibus, superiore arcuata, apice mucronulata, inferiore recta, longitudinaliter 1-sulcata; semine oblique ovato, depresso, funiculo in arillum anguste cupuliformem dilatato.

Arbor magna, duramine durissimo, purpureo, cortice griseo, ramulis foliisque glaberrimis. Stipulae 10 mm. longae, 6 mm. latae, stipellae 6–8 mm. longae. Petiolus 1.2–1.7 cm. longus, petioluli 3–4 mm. longi, lamina 5.5–6.5 cm. longa, 2.5–3 cm. lata, eleganter reticulato-venosa. Legumen 3 cm. longum, 1.6 cm. latum, pedicello 7 mm. longo. Semen 1.9 cm. longum, 1.1 cm. latum, "e legumine aperto ejectum diu tamen ei adhaerens."

Type in U. S. National Herbarium, no. 716,675.

PANAMA: On rocky hills along the Chucunaque River beyond Yaviza, southern Darien, young leaves only, April 22, 1914 (*Pittier* 6586); Punta Patiño, southern Darien, on hills along the seashore, leaves and mature pods (*Pittier* 6610,); also noticed by me in the dry forests around La Palma del Darien, and reported from Coiba Island.

Peltogyne purpurea, called *nazareno* or *morado* by the natives of Panama, is one of the most remarkable trees of the forest in the districts with a well defined dry period. It grows preferably on ridges free of higher vegetation. The height of a full grown tree is seldom less than 25 meters and the trunk reaches up to 60 cm. in diameter. The tree is evidently deciduous, as only very young leaves, with the stipules still attached, were found near Yaviza. But at Punta Patiño, a few days later, there were individuals with the old leaves and pods still on, and others with young shoots and leaves only.

One of the peculiarities of the morado tree is that the seed remains hanging from the dehiscent pod by the hilum after maturity, probably until the rainy season sets in. This curious habit, which has been observed also in *Peltogyne congestiflora* Benth., of Brazil, may be considered as a means of protection against ants and other insects, or the extreme dryness of the soil. On the tree, however, the seeds are not immune from attacks, as I found many of them inhabited by a coleopterous insect.

The wood of Peltogyne is very hard, the sapwood white and little developed, and the heartwood of a beautiful purple color.

Dimorphandra megistosperma Pittier, sp. nov., ramis teretibus, verruculosis, brunneis, glabris; foliis exstipulatis, glaberrimis, petiolo communi infra foliola inferiora anguloso, superne plano, subtus tereti; foliolis bijugis, oppositis, coriaceis, breve petiolulatis, oblongo-acuminatis, basi plus minusve inaequilateralibus, apice obtusis, supra nitidis, infra glaucis; floribus sessilibus, densissime spicatis, spicis terminalibus vel subterminalibus; calyce glabro, lobulis rotundatis, ciliatis; petalis oblongis, calyce subduplo longioribus, basi attenuatis, apice rotundatis plus minusve irregulariter emarginatis, margine scarioso ciliato; staminibus fertilibus corolla longioribus, filamentis crassis, leviter attenuatis, antheris apicem antice lanoso-barbatis, demum glabrescentibus; pistillo staminibus subaequante, stipitato, ovario 3-ovulato, dense lanoso, stylo glabro; legumine 1-spermo, glabro, coriaceo, dehiscente; semine maximo, extus brunneo, nitido.

Arbor excelsa, 15–45 m. alta, trunco erecto 10–15 m. longo, usque ad 1 m. diametro, cortice nigrescente, coma elongata. Rhachis foliorum 5–9.5 cm. longa, parte infra foliola inferiora 2.5–5 cm.; petioluli 3–4 mm. longi, incrassati; foliola 10–18 cm. longa, 4.5–7 cm. lata, reticulato-venosa. Spicae floriferae 8–10 cm. longae; calycis lobi inaequales, 3.5–4 mm. longi; petala alba, 6 mm. longa, 2.5–3 mm. lata; stamina et staminodia 7–8 mm. longa. Legumen usque ad 25 cm. longum, 13 cm. latum, leviter depressum. Semen phaseoliforme, usque ad 18 cm. longum, 12 cm. latum.

Type in U. S. National Herbarium, no. 716,658.

PANAMA: In groves, in the tidal forest along the Mamoní River, near its confluence with the Bayano River, Province of Panama, pods and leaves, October 23, 1911 (*Pittier* 4582); below Sumacate, along the Tuyra River, southern Darien, flowers, April 25, 1914 (*Pittier* 6593, type). This species was observed also along the Sta. Lucia River in eastern Chiriquí; around La Palma del Darien, on the margin of the mangrove forest; and along the lower course of the Sambú River, also in southern Darien.[1]

In the course of my exploration of Panama I had repeated opportunities to collect on the beaches of the Pacific and its tributary tidal rivers stray specimens of the enormous seed of the above described tree. Dr. M. A. Howe, of the New York Botanical Garden, had also gathered specimens of the same in the course of his explorations in 1910. The unusual size of this seed made me very anxious to know more about it from my own experience, especially since all queries among European and American botanists failed to procure further enlightenment about it. Finally, the tree producing these beans was discovered, on October 23, 1911, on a point of land at the meeting of the Mamoní and Bayano rivers, below Chepo, in the Province of Panama. Later on it was found again in Chiriquí and Darien, always playing an important rôle as a constituent of the forest of the tidal belt. But my discovery was only partial at that time, because I left the Isthmus without having been able to collect flowering specimens. It was not until April, 1914, that I had the privilege of seeing the *alcornoque*, as it is called by the natives, in full bloom in mile-long stretches along the lower course of the Tuyra River in southern Darien.

The alcornoque is a gregarious tree, seldom found as isolated individuals. With reference to the root system, there seems to be a great variety in the size of the buttresses and the way they part from the base of the trunk. At times they form large wings, generally three in number, reaching up the latter to a distance of 1.5 meters and over; at other times they are low and hardly noticeable. The main roots run horizontally on the surface of the ground and can often be followed

[1] In the Kew Herbarium there are specimens of a Panamanian tree, cited as *Dimorphandra oleifera* Triana in Hemsley's botanical part of the Biologia Centrali-Americana (**1**: 342). This species, collected by Sutton Hayes in the swamps of the Río Grande near Panama, has never been described. Through the courtesy of the Director of the Kew Gardens, I am informed that the species is "quite distinct from any species of Dimorphandra (Mora) represented here." In the absence of further data, however, and in order to avoid a possible confusion, I deem it preferable to describe under a new name the material collected by myself.

to a distance of some 15 meters from the trunk; they are flattened laterally and end in several secondary branches, each of which lies on the flat bottom, forming a succession of bow-like arches, with numerous rootlets growing downward at the lowest points. Around the base of the tree, in parts temporarily submerged, there appear sometimes bunches of thin roots, which are supposed to be pneumatophores.

The trunk is usually straight with a smooth, dark brownish, peeling bark. It will give logs of 6 to 8 meters, of any diameter up to 1 meter, of a pale brown, tough, close grained wood. The sap once excluded, this wood is, it is claimed, incorruptible and adapted as a substitute for oak or other hard timbers in their various industrial uses. According to another statement the wood of the alcornoque is better than any other for structures kept permanently under sea water.

The crown of the tree is elongated and the main limbs are rather short. The middle-sized specimen which was felled to procure herbarium material was 31 meters high; the trunk measured 10 meters in length and 75 cm. in diameter; the white sapwood had a thickness of 5 to 7 cm.; and the heart was dark reddish.

Botanically speaking the affinities of *Dimorphandra megistosperma* are with *D. excelsa* (Schaub.) Baillon, of British Guiana. Its leaves, however, are pinnate, with only 2 pairs of leaflets, instead of the 3 or 4 pairs of the latter. The floral spikelets are not paniculate but solitary at the end or in the upper axils of the branchlets. In the several ovaries which were dissected a constant number of ovules was found, 3, of which only one reaches maturity. The enormous pods, once ripe, open with a twist of the valves without parting from the branchlets, and the seed slips to the muddy ground, where germination starts almost immediately. From the cotyledons the natives extract by infusion a dark red dye.

The dimensions of the pods and seeds are variable. As reported in the description, the largest specimen found measured 18 cm. in length with a breadth of 12 cm. and a thickness of 8 cm.

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WRIGHT, FRED. E. *The optical character of the faint interference figure observed in high power objectives between crossed nicols.* J. Wash. Acad. Sci., **4**: 301–309. 1914.

WRIGHT, FRED. E. *A new half shade apparatus with variable sensibility.* J. Wash. Acad. Sci., **4**: 309–313. 1914.

WRIGHT, FRED. E. *The determination of the relative refringence of mineral grains under the petrographic microscope.* J. Wash. Acad. Sci., **4**: 389–392. 1914.

WRIGHT, FRED. E. *Measurements of refractive indices on the principal optical sections of birefracting minerals in convergent polarized light.* J. Wash. Acad. Sci., **4**: 534–542. 1914.

ENTOMOLOGY

CRAWFORD, J. C. *The species of Perilampidae of America north of Mexico.* Proceedings of the Entomological Society of Washington, **16**: 69–76. June 12, 1914. (Gives tables for the genus Perilampus, describing nine new species, and Chrysolampus, describing three new species.—J. C. C.)

CRAWFORD, J. C. *New parasitic Hymenoptera from British Guiana.* Proceedings of the Entomological Society of Washington, **16**: 85–88. June 12, 1914. (Describes three new Serphidoidea and three new Chalcidoidea.—J. C. C.)

CRAWFORD, J. C. *Some species of the bee genus Coelioxys.* Annals of the Entomological Society of America, **7**: 148–159, figs. 1–6. June, 1914. (Contains a key to the females of the species found north of the Mexican boundary and describes eight new species and one new variety.—J. C. C.)

CUSHMAN, R. A. *A new species of the braconid genus* Phanerotoma *Wesmael.* Proceedings of the Entomological Society of Washington, **16**: 78–79. June 12, 1914.

DYAR, H. G., and KNAB, F. *New mosquitoes from Peru.* Insecutor Inscitiae Menstruus, **2**: 58–62. April 24, 1914. (Describes *Phalangomyia debilis*, new genus and species, and *Aedes epinolus*, n. sp.—J. C. C.)

DYAR, H. G. *The pericopid larvae in the National Museum.* Insecutor Inscitiae Menstruus, **2**: 62–64. April 24, 1914. (Describes the larvae of some species and gives references to the descriptions of larvae which had been published previously.—J. C. C.)

DYAR, H. G. *The noctuid moths of the genera Palindia and Dyomyx.* Proceedings of the U. S. National Museum, **47**: 95–116. May 7, 1914. (Sixteen new species in Eulepidotis (Palinda) and one new species in Dyomyx.—J. C. C.)

HEIDEMANN, O., *O. M. Reuter.* Proceedings of the Entomological Society of Washington, **16**: 76–78. June 12, 1914. (A short biography giving a list of the papers by Dr. Reuter on American Hemiptera.—J. C. C.)

HEINRICH, C. *Notes on some forest Coleophora, with descriptions of two new species.* Proceedings of the Entomological Society of Washington, **16**: 66–69. June 12, 1914. (Describes three new species in this genus.—J. C. C.)

HOOD, J. D. *Two new Thysanoptera from Panama.* Insecutor Inscitiae Menstruus, **2**: 49–53. April 24, 1914. (Describes the new genus Holopothrips, based on two new species.—J. C.C.)

HOWARD, L. O. *Concerning some Aphelininae.* Proceedings of the Entomological Society of Washington, **16**: 79–85, *fig. 1.* June 12, 1914. (Describes Dirphys, new genus, and seven new species; gives a table of the species of Physcus.—J. C. C.)

KNAB, F. *Ceratopogoninae sucking the blood of caterpillars.* Proceedings of the Entomological Society of Washington, **16**: 63–66. June 12, 1914. (Gives records of these flies sucking the blood of caterpillars and describes *Forcipomyia erucicida* and *F. crudelis*, new species.—J. C. C.)

KNAB, F. *Supplementary notes on Peruvian Simuliidae.* Proceedings of the Biological Society of Washington, **27**: 123–124. July 10, 1914. (Describes one new species and gives notes on others.—J. C. C.)

MCATEE, W. L. *Key to the nearctic genera and species of Geocorinae.* (*Heteroptera; Lygaeidae.*) Proceedings of the Biological Society of Washington, **27**: 125–136. July 10, 1914. (In addition to key to the genera of Geocorinae of the world, describes the new genus Isthmocoris together with *Geocoris carinatus*, sp. nov., and *G. punctipes* var. *paulus*, var. nov.—J. C. C.)

MALLOCH, J. R. *American black flies or buffalo gnats.* U. S. Department of Agriculture, Bureau of Entomology, Technical Series, No. 26. Pp. 1–70, pls. 1–6. April 6, 1914. (Includes tables for the known larvae and pupae, as well as for the adults; describes the new genus Parasimulium and thirteen new species, and proposes the new name *lutzi* for *minutum* Surcouf & Gonzales-Rincones, not Lugger.—J. C. C.)

MALLOCH, J. R. *Description of a new species of Agromyza from Porto Rico.* Proceedings of the Entomological Society of Washington, **16**: 89–90, *fig. 1.* June 12, 1914.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE CHEMICAL SOCIETY OF WASHINGTON

The 246th meeting was held at the Cosmos Club, March 11, 1915. W. D. BIGELOW, Director of the Research Laboratory of the National Canners' Association, gave an illustrated lecture on *Some of the problems and difficulties of the canning industry.* Motion pictures were presented showing the work of the Bureau of Chemistry with the various canning industries, especially along the line of the betterment of sanitary conditions in the sardine packing industry, and the solution of the difficulties encountered by corn-packing establishments. The scope of the work of the Canners' Laboratory was given and many of the specific problems were outlined, such as the causes of the darkening of corn and other packed materials, the effect of the nature of the tin plate used in can manufacture on the finished pack, etc. The latter point is being made the object of an extensive investigation by the makers and users of tin plate in coöperation with the government.

Under the head of informal communications H. C. GORE, of the Bureau of Chemistry, discussed the *Preparation and uses of calcium acid malate.* This material is readily prepared from what is ordinarily apple refuse and offers possibilities as a substitute for the acid constituent used in baking powders. Samples of the materials were shown.

The 247th meeting (special) was held at the Cosmos Club, March 17, 1915. Mr. W. S. LANDIS, Chief Technologist of the American Cyanamid Company, presented an illustrated lecture on *The fixation of atmospheric nitrogen.* A review of the methods for the fixation of nitrogen in commercial use was presented, giving particular attention to the manufacture of cyanamid which according to the speaker occupies a preëminent place and has been making steady progress since its introduction by Frank and Caro. Many of the uses of cyanamid in the chemical industries and agriculture and as an intermediate product in the production of ammonia were described. Motion pictures showing the plant of the American Cyanamid Company at Niagara Falls, Canada, in operation presented an interesting feature of the lecture. This lecture is published in full in the *Journal of Industrial and Engineering Chemistry*, **7**: 433–8 (1915).

The 248th meeting was held at the Cosmos Club, April 8, 1915. H. D. GIBBS, of the Bureau of Chemistry, presented a paper entitled, *A study of some palm trees, with special reference to the sugar and alcohol industries.* Practically all the alcohol used in the Philippines is obtained

from the sap of palm trees; 97 per cent of this is used for beverages and 3 per cent for industrial purposes or export. While several varieties of palm trees are the source of alcohol in the tropics, the Nipa palm overshadows all for this purpose in the Philippines and may be regarded as the cheapest source of alcohol in the world, the cost of raw materials being about two cents per liter. The sap has at present no value as a source of sugar, as it rapidly becomes impure. When fresh it contains 15 per cent sucrose. Inversion may be prevented by the addition of milk of lime, and enzyme action inhibited by means of SO_2. Sugar obtained in this way on a small experimental scale showed this source to be cheaper than the use of beets or cane; 150 kg. were obtained from 1000 *l* of sap. The lecture was illustrated by slides showing the various palm trees and the mills used in the experimental work.

There was some discussion as to the nature of the changes in the sap and their cause.

C. S. HUDSON, of the Bureau of Chemistry, spoke on *The acetyl derivatives of the sugars.* A brief review was given showing the various new sugars and types of sugars obtained by acetylation. This reaction is easily carried out except where the sugar is easily hydrolysed. In general the new compounds were crystalline with sharp physical properties. Oxyacetate were also prepared. The preparation of these compounds is important from the standpoint of the constitution of cellulose. More detailed information regarding these compounds and the latest developments are given in papers published in the *Journal of the American Chemical Society*, **37**: 1264, 1270, 1276, 1280, 1283, 1589, 1591 (1915).

Under the head of informal communications, Mr. J. B. TUTTLE, of the Bureau of Standards, spoke on *The requirements and purchase of rubber tubing for laboratory purposes.* The difficulties incurred at the Bureau of Standards in obtaining rubber tubing with a reasonable life and satisfactory rubber content were outlined. Former sources of supply have been cut off by the war and an effort is being made to have American manufacturers take up the manufacture of a good grade of laboratory tubing at a reasonable price. Such samples are now being tried out at the Bureau of Standards.

The 249th meeting (special) was held at the Cosmos Club, April 21, 1915. Prof. A. A. NOYES, of the Massachusetts Institute of Technology, gave a lecture on *A system of qualitative analysis including nearly all the elements.* The speaker reviewed briefly and gave the present status of the work on this subject that has been under way at the Institute for some twenty years. This lecture was also delivered on the occasion of the acceptance by the author of the Fifth Willard Gibbs Medal at Chicago, April 16, 1915; a brief abstract of it will be found in the *Journal of Industrial and Engineering Chemistry*, **7**: 450 (1915).

While the work is not finished in all its details, the fundamentals have been well established and we may expect soon a system of qualita-

tive analysis that has its quantitative aspects also from the standpoint of adequacy and limits of the separation process.

The 250th meeting was held at the Cosmos Club, May 13, 1915. Members of the American Chemical Society resident in Virginia with the exception of Alexandria county have withdrawn, with the permission of the council, from the Washington section, forming a Virginian section with headquarters at Richmond. This withdrawal reduces the membership of the local section from 371 to 318 members, of whom 14 reside in Maryland.

Mr. R. R. WILLIAMS, of the Bureau of Chemistry, formerly of the Bureau of Science, Manila, P. I., presented a paper entitled *Vitamines and beriberi*. The proof of the existence of substances now called vitamines was an outgrowth of the study of beriberi. This is still a disease of primary importance in Oriental countries, though the etiology is now fairly established. Extensive studies and observations throughout the world have shown that the beriberi is produced by the exclusive consumption of a specifically deficient diet such as rice. The deficiency which produces the pathological condition is solely one of so called vitamines. These are ashfree nitrogenous substances which occur in minute quantities in some foodstuffs and are absent in others. Their existence and nature was first demonstrated by Funk in 1911, who was able promptly to cure polyneuritis in fowls by administration of relative minute amounts of a product separated from rice polishings or yeast. As yet, however, no vitamine has been isolated in a pure condition and we have little knowledge of their chemical nature. Twenty-seven cases of human beriberi were treated with vitamine preparations from rice polishings. The result of this treatment proved no less prompt and radical in the case of human beriberi than it had already been shown to be in polyneuritis gallinarum, thus demonstrating more conclusively the essential identity of the two. A temperature reaction was observed following the administration of vitamines to human patients.

The suggestion was offered that beriberi is due to a metabolic toxaemia which is inhibited or corrected by administration of vitamines. The chemical and pathological evidence in favor of this theory was reviewed and some experimental evidence presented that polyneuritis may be produced by the ingestion of the internal organs of birds dying from the disease resulting from white rice feeding. This view of the function of the vitamines appears to account rationally for the observed facts regarding beriberi. The conception of the vitamines as foods necessary for tissue construction must be subjected to further critical investigation (author's abstract).

Discussion: Dr. VOEGTLIN in the discussion remarked that the modern method of milling corn does not appear to account for pellagra. A similar deficiency is however believed to be important in this disease as well as beriberi.

Dr. SALANT said he had found carrot-fed rabbits more resistant to the toxic effects of tartrates and certain heavy metals than were animals fed on other diets, such as oats.

E. C. MCKELVY, *Secretary*.

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 295th meeting was held in the lecture room of the Cosmos Club on April 14, 1915.

INFORMAL COMMUNICATIONS

E. W. SHAW: *Sulphur in rocks and in river waters.* Sulphur is indicated by analyses to be about 36 times as abundant in rivers as in rocks and yet the mineral matter of rivers must come directly or indirectly from the rocks. Several questions arise. Is the sulphur being brought back from the sea to the land so that it makes two or more trips while other elements make one? Evidently not. Are there other agents which carry loads in which sulphur is scant or wanting? The dust carried by the wind probably contains very little sulphur, but the quantity reaching the sea is small compared with the rock waste carried by streams. The clay, silt, sand, and gravel carried by streams contain, no doubt, less sulphur than the rocks do, and assist considerably in explaining the discrepancy, but it is known that the amount of material carried in suspension by streams is not more than about twice that carried in solution, and hence if the suspended matter contains no sulphur at all the discrepancy would still be about 1200 per cent. The bottom load of streams is an unknown quantity, but it is probably considerably less than the suspended load. Is sulphur more abundant in rivers because sulphur compounds are in general more soluble than others? The long periods of geologic time and great amount of erosion which the lands as a whole have suffered would seem to nullify this possibility, for in the lowering of a land surface hundreds or thousands of feet, both soluble and insoluble materials, must be removed. But the removal may not proceed at a uniform rate and hence arises the question as to whether or not present conditions are unusual. Apparently they are, first, because of the activities of man in bringing sulphur-containing minerals—pyrite, gypsum, etc.—within reach of streams; and second, because of a generally lower position of ground water surface and thicker zone of active oxidation at present due to the unusual height of the continents and to the withdrawal of water from wells. Coal mining alone is apparently responsible for a considerable part of the discrepancy, especially since most of the waters analyzed come from well settled regions. However, a part of the sulphur sent into the atmosphere is carried out over the ocean and there brought down by rain. Finally, it appears that the amount of sulphur in the earth's crust has been underestimated because, first, the specimens of sedimentary rocks analyzed were taken from at or near the surface where much of the sulphur has been leached out and carried away, and second, because sedimentary rocks are weighted at only 5 per cent, whereas most of the waters have access only to such rocks. The moral is that composite samples of strata lying below the surface of ground water should be made up and analyzed.

F. C. SCHRADER: *A sulphide-bearing monzonite from Arizona.* A description of a monzonite was given, in which pyrite, chalcopyrite, and molybdenite are disseminated throughout the entire rock, apparently as original constituents. Green copper stains are quite common on the rock, and a few mining prospects have been started.

Discussion: A. C. SPENCER said that in his study of the disseminated copper ores of Ely, Nevada, the microscopic examination had led him to infer at first that the copper minerals in these bodies had been deposited as original constituents. He had later come to the conclusion that his first impressions were wrong. SCHRADER said that in his specimens the copper ores occupied an interstitial position as regards the quartz and feldspar. In similar California occurrences described by Turner the same relations had been found. From such relations the original nature of these constituents had been inferred.

REGULAR PROGRAM

J. B. MERTIE: *Copper and gold deposits of the Kotsina-Kuskulana District, Alaska.*. The Kotsina-Kuskulana District lies on the south flank of the Wrangell Mountains. The geologic column in this area is as follows: At the base there is a formation composed essentially of tuffs, interbedded lavas, and basic intrusives, with which are associated minor amounts of argillite and limestone. Fossils from the sedimentary members have been determined to be of Carboniferous age. Overlying this conformably is a series of altered basaltic lava flows, about 6,500 feet thick, which are designated as the Nikolai greenstone. Lying upon the Nikolai greenstone without apparent disconformity is the Chitistone limestone, a formation of upper Triassic age about 700 feet thick. This grades upward into thin-bedded limestone and shale, likewise of upper Triassic age, which comprise probably about 5,000 feet of sediments. The youngest hard-rock formations of the area include massive conglomerates, sandstone, and limestone of upper Jurassic age, which lie unconformably on all the underlying formations. Glacial and recent stream gravels occur along the drainage channels. Dioritic rocks intrude all the formations up to and including the upper Triassic sediments.

The copper deposits occur in the basal formation, in the Nikolai greenstone, and to a minor extent in the Chitistone limestone. The copper minerals commonly found are bornite, chalcocite, chalcopyrite, malachite, azurite and native copper, but not all of these are found in any one deposit. The gangue minerals are quartz, epidote, and calcite. The loci of the copper deposits are shear zones. The ore-bodies are irregular in shape and of doubtful persistence. Five types of ore deposits are recognized. All of these types, with the exception of the native copper deposits, are thought to be primary. The presence of a quartz-epidote gangue in much of the ore, considered in relation to numerous quartz-epidote veinlets which have their maximum development in the vicinity of the dioritic intrusives, leads to the belief that the ore deposits are connected genetically with the intrusive rocks. The

gold deposits are confined to the basal member of the geologic column. The gold occurs both in the native state, and intergrown with pyrite. The gangue is dominantly siliceous, with calcite occasionally present. The gold ores are more often in well-defined veins than are the copper deposits.

Discussion: SIDNEY PAIGE inquired whether acid solutions might be capable of depositing the calcite of the ore-bodies, as might be inferred under the supposition that the deposits were due to atmospheric waters. MERTIE thought it unlikely. SCHRADER inquired regarding the thickness of the basal formation. MERTIE explained that folding made it difficult to compute this, but thought that it was probably about equal in thickness to the Nikolai greenstone, or 6,500 feet.

CHASE PALMER: *The silver precipitating capacity of certain arsenides as an index of their constitution.* The speaker described a number of experiments he had made on certain metallic arsenides, in which they had been subjected to the action of silver solutions. Their silver-precipitating capacity was believed to afford an indication of the valence of the iron present.

Discussed by SIDNEY PAIGE.

G. W. STOSE: *The mechanics of a cross fault in the Northern Appalachians.* Cross faults in the Appalachians are generally of two kinds: (1) Faults in which the thrust plane is so flat that, when slightly folded, erosion produces deep reëntrants across the strike; (2) shear faults accompanying thrust faults, resulting from differential displacement. The fault here described is of the latter class.

South Mountain is broken by a cross fault in southern Pennsylvania. The rocks affected are pre-Cambrian lavas, Cambrian sandstones, quartzites, conglomerates, and shales, and Cambro-Ordovician limestones. The fault passes under cover of the Triassic sediments east of the mountain. Adjacent to the cross fault the formations have been offset a mile or more. Drag of the beds along the fault is conspicuously shown on both sides. A transverse depression across the mountain eroded along the crushed zone of faulting conceals the exposures, so that fault brecciation was not observed, but the adjacent metarhyolite is crushed and intensely jointed. Two major anticlines and the enclosing syncline are the chief structures in the area. Overturned folds and a prevailing southeastward-dipping schistosity show that the direction of thrust and pressure at the level here studied is from the southeast. Therefore the eastern of the two anticlines was the first to rise, and the oldest pre-Cambrian rocks are brought up along its axis. The western anticline did not rise so high and is still capped by the massive Cambrian sandstones which plunge south and pass under the limestone at the cross fault. North of the cross fault this western massive anticline of sandstone blocked the way to further westward movement and the rocks in the syncline between the two anticlines were intensely folded and faulted. South of the cross fault, however, the Cambrian sandstone lay so low that westward movement was not

obstructed, but found relief in an overthrust fault in the limestone to the west. The differential horizontal movement resulted in shearing along the plane of the cross fault, which is nearly vertical, and passes into the thrust fault to the west.

Discussion: A. C. SPENCER remarked that it was to be regretted that the later Triassic sediments concealed the relations so that the extension of the fault to the eastward could not be traced.

SIDNEY PAIGE asked whether the cross-cutting portion of the fault was necessarily vertical. Might it not have a rather shallow dip? STOSE explained the evidence which pointed to a steep dip. D. F. HEWETT inquired whether there was any indication of thickening of strata on the limbs of the folds which had been described. STOSE replied that there was no evidence of this. SIDNEY PAIGE asked regarding the evidence of faulting and as to the presence of igneous masses to whose intrusion the compression and folding could be ascribed. STOSE cited a number of features which gave evidence of the fault. Regarding intrusions, he said that there was nothing of the kind near enough to attribute the compression to this cause. R. B. SOSMAN inquired whether the injections of Triassic basalts showed any connection with the fault. STOSE replied that none was shown.

C. N. FENNER, *Secretary.*

The 296th meeting was held in the lecture room of the Cosmos Club on April 28, 1915.

INFORMAL COMMUNICATIONS

SIDNEY PAIGE: *A model illustrating character of faulting at the Homestake ore-body.* At a previous meeting of the Society the speaker had suggested an hypothesis to explain the origin of the Homestake Ore-Body of Lead, South Dakota. At that time it was pointed out that stratigraphic work on the pre-Cambrian had shown the presence of a fault, on the two sides of which the schist series had divergent strikes, and that the series on the eastern side terminated at this fault line. It was also shown that dolomitic limestones and their impure schistose equivalents formed an important member of the series and occupied precisely the outcrops of the Homestake Ore-Body along the fault line. The folded character of these beds was pointed out and the significance of these folds in determining the shape of the ore-body at various levels within the mine was emphasized. To portray this relationship a plaster model has been constructed and a wooden copy made. Very simple structural assumptions (based on field observations) were made in constructing this model. An anticlinal fold was modeled in wax; on the main fold minor folds were imposed much after the fashion of innumerable instances observed in the field. This fold was given a pitch, was cut at an oblique angle by a fault, and was penetrated by horizontal mine levels. The results are shown in the model. Considering that the solutions which formed the ore-body rose along the fault-plane and permeated the calcareous series for a

certain distance only, it is not difficult to see the resemblance between the artificial mine levels and the actual shape of the ore-body as shown on the maps of the 300, 400, and 500-foot mine levels published in U. S. Geological Survey Professional Paper No. 26.

F. C. SCHRADER gave abstracts of the following papers: *Magmatic copper sulphide deposits in Plumas County, Cal.*, by H. W. TURNER and A. F. ROGERS. *Iron ore deposits of Kiruna, Sweden*, by R. A. DALY.

Discussed by LA FORGE and A. C. SPENCER.

REGULAR PROGRAM

C. W. GILMORE: *Some new dinosaurs* (illustrated). The speaker discussed briefly some of the more important discoveries of dinosaurian fossils made in North America during the past two or three years, referring especially to the explorations conducted by the American Museum of Natural History and by the Canadian Geological Survey in the Edmonton and Belly River formations in the Province of Alberta, Canada. He stated that the recent finding of several specimens, with which were preserved impressions of considerable parts of the epidermal covering, leads us to hope that the time is not far distant when the external appearance of these animals will be as well known as is the internal skeleton. Lantern slides of many of the more striking specimens were shown, the speaker confining himself to brief explanatory remarks regarding their systematic position and their more striking characteristics. The following forms were discussed, *Saurolophus*, and *Corthyosaurus* of the trachodont dinosaurs; *Ankylosaurus*, an armored reptile; *Monoclonius*, *Anchiceratops*, *Ceratops*, *Styracosaurus*, and *Brachyceratops*, all of the Ceratopsia or horned dinosaurs. In conclusion life restorations of *Brachyceratops*, *Thescelosaurus*, and *Stegosaurus* modeled by the speaker were exhibited for the first time.

Discussion: SIDNEY PAIGE asked by what means it was possible to distinguish in dinosaurs between adult and young individuals. GILMORE said that the principal distinguishing feature was that in the young the sutures of the skull were open, and in the adult they became closed. R. S. BASSLER spoke in appreciation of GILMORE's work and referred to the scientific attainments and artistic skill required to make the restorations.

C. N. FENNER: *A geological reconnaissance of Porto Rico* (illustrated). The New York Academy of Sciences, with the coöperation of the Insular Government of Porto Rico, has undertaken a natural history survey of the island. A number of expeditions have already been sent out and have made preliminary studies in the botany, zoology, anthropology, geology, etc. The geological expedition consisted of Prof. Berkey, of Columbia University, and the speaker. They spent four weeks on the island during the past summer. A description was given of the principal geologic and topographic features, most of which were illustrated by lantern slides. (The chief results of the expedition have been published by C. P. Berkey in *Annals N. Y. Acad. Sci.*, **26**: 1–70. 1915.

Discussion: T. WAYLAND VAUGHAN stated the results of his expedition to Antigua, St. Bartholomew, and Anguilla in 1914, and gave a résumé of the present status of the geologic correlation of the Cretaceous and Tertiary formations of the Antilles.

Cretaceous: The peculiar Upper Cretaceous fauna of Jamacia has also been found in Cuba and St. Thomas. HILL has noted in Porto Rico "volcanic tuffs and conglomerates with interbedded Cretaceous rudistean limestone similar to that of Jamacia," thereby confirming a previous inference of Cleve that the same horizon which he found in St. Thomas also occurred in Porto Rico. Quin figures a specimen of *Barrettia* from the "Blue-beach" formation of St. Croix and a similar fauna occurs in Mexico. This fauna is closely related to that of Gosau, Austria. Gabb reports Cretaceous in Santo Domingo.

Eocene: Miss MAURY has described from the lower beds of Soldado rock, Trinidad, a fauna which corresponds to that of the Midway group in Alabama, and she correlates the fauna of the uppermost bed of Soldado rock with that of the Wilcox group. VAUGHAN's studies of the fossil corals of Jamaica and St. Bartholomew resulted in the correlation of the Richmond and Catadupa beds of Jamacia with the coraliferous limestone in St. Bartholomew. These deposits appear to correspond to the Ocala limestone of Florida and Georgia. The same or a closely related horizon is represented in Oriente Province, Cuba, in Panama, and in the island of Trinidad. HUSSAKOF has described an Eocene marine fish from Antigua.

Oligocene: VAUGHAN in 1900 correlated the fossil coral reef beds of Antigua with the base of the Chattahoochee formation of Bainbridge, Georgia. DALL identified *Orthaulax* in collections from Antigua, showing that the deposits correspond to the upper group of Oligocene deposits in the southern United States. This horizon or a closely related one has been recognized by VAUGHAN through collections from the following localities: 4 miles west of Lares, Porto Rico; in Oriente Province, Cuba; in Province of Pinar del Rio, Cuba; in eastern Mexico; and in the island of Arube, Netherlandic West Indies. The lower part of the fossiliferous marls and limestones of Anguilla are slightly younger. They may be correlated with the upper portion of the Chattahoochee formation of Georgia and Florida, with the Tampa formation of Florida, and with the Emperador limestone of Panama. DALL has shown that this, or a closely related horizon, is found in Santo Domingo. DALL has indicated parallelism between the Bowden beds of Jamaica and the Chipola horizon in Florida. The Bowden horizon, as is shown by fossil corals, is present at several places in eastern Costa Rica. Perhaps the upper part of the Anguilla limestone and marls may be of this age. Upper Oligocene deposits are wide-spread in Cuba, Costa Rica, and Panama.

Miocene: As no undoubted Miocene has been identified in the West Indies, this is supposed to have been a period of high uplift.

Pliocene: Pliocene has not been positively identified in the West Indies, but some of the fossil corals from Santo Domingo are sug-

gestively similar to species found in the Caloosahatchee marl of Florida.

R. T. HILL spoke of work which he had done years before in the West Indies, and expressed gratification that the New York Academy of Sciences had taken up the Porto Rican field. He mentioned some of the structures which had been exhibited in the views and advanced the opinion that the islands of Porto Rico, Santo Domingo, and Cuba, with the connecting banks, represented horsts left at a high relative elevation by the down-sinking of faulted blocks at the sides. SIDNEY PAIGE inquired about the structures shown in the San Juan formation, whose origin FENNER had ascribed to the consolidation of old sand-dunes. He thought that for such an origin the cross-bedding should be of a somewhat different type than that shown. FENNER replied that the reference to such an origin had been made because of the areal distribution of these hills along the north coast and because of the internal structures, which were difficult to account for otherwise. A. C. SPENCER inquired as to whether any mineral deposits had been seen and as to the mineral resources of the island. FENNER replied that indications of mineral were known at various places and several of these had been visited. The only active work being done was a little gold-washing by natives along streams, but prospects had been opened up in gold, copper, lead, and iron.

R. B. SOSMAN: *Types of columnar structure in igneous rocks* (illustrated). From the physical standpoint two principal types of columnar structure may be distinguished. The first and most common is that due to contraction of the crystallized rock during cooling, whereby strains and stresses are produced which yield different sizes and kinds of prisms according to the magnitude of the temperature gradient, the rate of cooling, and other factors. The second type arises from convectional circulation of the still liquid rock. Experiments on low-melting materials have demonstrated that the vertical transfer of heat by convection is capable of dividing a liquid into hexagonal cells which leave their record in the crystallized mass and control its further division by contraction into hexagonal columns. The two methods produce prisms which differ in attitude, in the relation of diameter to length, in the frequency of 4, 5, 6 and 7-sided polygons, in the frequency of certain angles, and in the type of their cross-jointing. Attention was especially called to the usefulness of quantitative data on prismatic structures in igneous rocks as an index to the original conditions of occurrence of the rocks containing these structures.

C. N. FENNER,
C. H. WEGEMANN, *Secretaries.*

The 297th meeting was held in the lecture room of the Cosmos Club on May 12, 1915.

INFORMAL COMMUNICATIONS

R. B. SOSMAN: *Two subordinate types of prismatic structure.* In addition to the two principal types discussed at the meeting of April 28, two subordinate types should be distinguished. The first

of these is due to contraction in a physically heterogeneous material (mixture of solid and liquid) and is fundamentally different from the type produced by prismatic division in a cooling solid; a common example is mud cracks produced by drying. The second type is due to internal expansion, whereby the surface is stretched and broken; a prismatic structure produced in a cement briquet by internal expansion was shown as an example. It was suggested that the "weather cracks" on the surface of diabase boulders are of this type, and that they are due to sub-surface hydration and expansion, which produces a tension in the surface of the block.

REGULAR PROGRAM

R. C. WELLS: *The solubility of magnesium carbonate in natural waters.* Under atmospheric conditions at 20°C. magnesite was found to dissolve in pure water to the extent of 0.018 gram magnesium and 0.065 gram total carbon dioxide per liter, and somewhat more in solutions of other salts. But some natural waters freely exposed to the air contain much more magnesium and carbon dioxide than this. A true equilibrium was obtained at 20° only with $MgCO_3.3HO_2$ as solid phase, the final solubility being 0.37 gram magnesium and about 1.00 gram CO_2 per liter.

Discussion: T. WAYLAND VAUGHAN said he had been greatly interested in a closely related subject—that of the solubility of calcium carbonate in sea-water. He had come to the conclusion that the sea-water was very nearly saturated with calcium carbonate and that anything which disturbed the equilibrium would be apt to precipitate the carbonate. He had experiments in mind to ascertain whether $MgCO_3$ might not be thrown down with $CaCO_3$ under natural conditions.

W. H. FRY: *The weathering stability of minerals as illustrated in soils and soil-like materials.* Soils from various climatic, physiographic, and geologic regions of the United States were examined petrographically. The minerals identified are as follows: quartz, orthoclase, plagioclase, muscovite, biotite, hornblende, augite, calcite, dolomite, chlorite, serpentine, olivine, kaolin, sericite, limonite, hematite, magnetite, and a great variety of less common minerals. As to mineralogical composition, the various soils resemble each other qualitatively; but quantitatively they differ widely. Orthoclase occurs both fresh and altered. Microcline always occurs as fresh fragments. Acid plagioclases generally appear as fresh grains, while the more basic ones are at times deeply altered. Hornblende sometimes shows a tendency to alter to chlorite. Epidote shows practically no signs of chemical alteration. The micas are apparently very stable. Tourmaline, rutile, and zircon usually occur as fresh crystals, although occasionally the edges are rounded. Garnet appears to be fairly resistant. Magnetite appears to alter to the hydrated sesquioxide of iron. Quartz is the most abundant of the soil minerals, and occurs both as primary and secondary grains. Judging from the mineralogical composition, the processes of soil-weathering tend to leach out the alkalies and alkaline earths, to separate

iron as the oxide, leaving silica and insoluble Mg and Al silicates. In general, the percentage of quartz increases with increase of exposure of the soil to the weathering agencies.

Discussion: R. B. SOSMAN inquired whether any distinction is made between the effects of purely mechanical processes of destruction and those due to chemical alteration. FRY replied that in soils there was usually no means of finding out which process had been most effective. D. F. MACDONALD inquired whether sizing had been used in the analysis of soils. FRY said that it had. F. E. WRIGHT asked as to percentage of quartz grains in soils, and also as to whether the mineral composition gave any indication of fertility. FRY answered that in the Norfolk soil the silica formed 97 per cent. As to fertility, the mineral composition formed at least as good a basis for judgment as chemical analysis. E. T. WHERRY asked whether the secondary enlargement of quartz grains took place after the grains had left the parent rock. FRY said he had no means of deciding this. LA FORGE asked regarding limestone soils—whether the variety of minerals found could be attributed to contributions by wash from foreign sources. FRY said that limestone soils showing no such contributions possessed a great variety of minerals.

G. R. MANSFIELD: *Geology of the Fort Hall Indian Reservation, Idaho.* The physiographic history is complex, involving at least three cycles of erosion. Numerous physiographic features are due to vulcanism. The sedimentary rocks include a long sequence of formations ranging in age from early Cambrian to Quaternary, but with no representatives of the Cretaceous. The geologic section corresponds with that of the Montpelier district in southeastern Idaho. The revision of certain Triassic formations in the reservation is found advisable. The Nugget sandstone is divisible into four members: (4) main sandstone member 1500± feet thick, (3) Wood shale 220–250 feet, (2) Deadman limestone 150 feet, (1) Higham grit 500 feet, at the base of the formation. The Thaynes limestone becomes the Thaynes group with three members: (3) Portneuf limestone at the top 1500± feet, (2) Fort Hall formation 800 feet, (1) Ross limestone 1350 feet. Igneous rocks occur in considerable variety and abundance, with much fragmental material. An interesting single occurrence of nepheline basalt is reported. The general sequence of igneous rocks seems to have been (1) an earlier basic or intermediate lava, (2) acid eruptives, (3) basalt, (4) latite, the last being perhaps as late as middle or late Pleistocene. The structure is very complex in detail and is marked by both faulting and folding. There seem to have been at least three epochs of deformation. The Putnam Overthrust, a fault comparable with the Bannock Overthrust and with other great faults in the Rocky Mountain region, is particularly noteworthy. Phosphate deposits occur in the eastern part of the reservation. The main bed appears to average about 6 feet in thickness and to be of 70 per cent or better quality. The tonnage estimate for the reservation is 738,526,700 long tons. Other mineral deposits of the reservation are negligible

except the great deposits of volcanic ash, which may later have some value as abrasives.

Discussion: J. B. UMPLEBY spoke of several points which had interested him because of his work in the Mackay district. The general sequence of formations in the two districts was quite similar, and the sequence noted by LINDGREN in the Boise district was also similar, but the thickness of members of the Paleozoic rocks and certain other characteristics were quite unlike, and in the Hailey district there is little in common. R. B. SOSMAN spoke of the vanadium content of the phosphate rock and asked if this was deleterious in using as a fertilizer. There seemed to be no information on this point.

C. N. FENNER, *Secretary.*

ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 485th meeting of the Society was held in the Public Library, March 16, 1915, the program consisting of a paper by Dr. MANUEL V. ARGUELLES, University of the Philippines, Manila, P. I., entitled, *The Filipino racial complex.* The lecturer defined the present Filipino race as a mixture of Malay stock from the South, with an infusion of Chinese and Hindu, their early culture being largely of Chinese origin. The aboriginal occupants of the islands were represented by the surviving Negrito remnant, a black dwarfish race of lowest culture status.

At the 486th meeting of the Society, held April 6, 1915, in the Public Library, Dr. GUDMUND HATT, of the University of Copenhagen, read a paper entitled *At home with Lapps and reindeer,* which was illustrated with lantern slides. The Lapps, or Samoyed (Samid), live in the northern part of Norway, Sweden, and Finland, and on the Kola peninsula in Russia. Of the total number of 30,000, about 6000 are reindeer nomads. The nomadic Lapps are a factor of economic value, for by means of their large reindeer herds they utilize vast stretches of mountain land which otherwise would be of no value. Although the Lapps have for centuries been under strong influences from the surrounding peoples, they retain much of their old culture. This is due to the fact that old thoughts and habits are closely and necessarily connected with their nomadic life as reindeer herders. They cannot further their business by imitating sedentary populations. The inner life of the mountain people, therefore, although they are thoroughly Christianized, still retains important old traits, which, however, are not easily noticed by foreign observers. The younger generation does not retain much of the old thought, but among the middle-aged and the old are still found beliefs, customs, and tales that supplement and interpret their early mythology.

According to Lappish beliefs, the world is full of supernatural powers, which are not clearly defined or classified. These seem to have been recruited from the ghosts of the dead. A belief in an underground people is prominent. These are called by some Lapps "saivo," and are

generally invisible and haunt certain saivo places. These saivo people are believed to be reindeer breeders. Several facts make it appear that the saivo world originally was the world of the dead; thus, in some shamanistic tales the shaman goes to the saivo world to fight for the recovery of a sick person, and until recent years offerings have been made to the saivo world, in order to prolong the life of a person. A belief is also common in certain vagrant spirits, "muones," who bring sickness to people; their traits disclose their original nature as spirits of the dead, although they are not now always conceived as such. The Lappish shaman, or noaide, still uses the ghosts of dead persons as helping spirits. There is, however, also among the Lapps a belief in local spirits, which probably have nothing to do with the spirits of the dead. According to the beliefs of the northern Lapps, every thing and every locality may be inhabited by local spirits, "haldek," who in some way are the owners of these localities. In Pithe he heard a Lapp woman sing a song to the locality when the tent was set up in a new place, and a song of parting when the camp was moved again. Important supernatural powers are connected with the lodge, in which every place has some occult significance. The place behind the fire is still sacred; the fire itself or the powers of the fireplace have some intimate connection with the renewal of life, as can be seen from certain old customs.

The Lapps have always been considered great magicians. The magic drum, which was still in use in some parts of Lapland 50 years ago, has now disappeared, and magic is much less prominent than in earlier times. As magic knowledge is a personal possession which loses part of its power by being given to others, information is hard to obtain. The main purposes of Lappish magic are, to bring sickness and death to men and reindeer and to cure sickness. Sickness is always due to some sort of spiritual contagion, which may come from the dead but also may come from the earth, stagnant water, whirlwinds, or certain rocks. The evil influences are driven back to the place whence they came, by terrifying the hostile power. The magician, therefore, in his magic formulas, talks in a superior and commanding way to the sickness-bringing power. In order to remove the evil influence, the sick part may be touched by the same object from which the evil came—very much as electricity is unloaded by means of a conductor. The two concepts, individual spirits and supernatural power, are in Lappish magic and religion usually connected; but in some cases the idea of power itself is so highly emphasized that it seems devoid of personality.

The idea of reindeer luck is characteristic of the Lapps. Reindeer luck is the standard form of happiness, for which our modern idea of wealth can not be substituted. In order to insure reindeer luck, sacrifices until lately have been in vogue. The main feature in sacrifice of reindeer is that not a single bone must be broken, for in the bones resides the vital principle, and in the saivo world the bones will again be clothed with flesh. In ordinary slaughtering no bone is hurt; the slaughtering of reindeer must be done in accordance with old rules.

Reindeer bones were in former days sometimes placed in a spring; this was believed to restore life. According to Lappish ideas the relations between reindeer and man are rather intimate. In former days the same deity took care of the birth of children and of reindeer calves. A reindeer's life can buy life for man, and the life of a human being can buy reindeer luck.

At the 487th regular and 36th annual meeting of the Society, held April 20, 1915, Dr. HENRY R. EVANS, of the Bureau of Education, read a paper on *The old and new magic*. In addition to explanations given in his book under this title, the speaker held, in common with others taking part in the discussion, that thought transference and even hypnotism might be the real explanation of peculiar phenomena exhibited by so-called mediums and chlairvoyants. At any rate, this would throw light upon some of the spiritualistic seances in which he had taken part. In interviews with "psychics" in different parts of the country, a knowledge was shown by these exhibitors of the occult that could not possibly have been obtained through any ordinary channels of information. Although "orthodox" science sneers at so-called telepathy, many eminent psychologists have little doubt that there is a basis of fact underlying clairvoyance and thought transference which has not as yet been fully worked out in a scientific manner.

Mr. J. N. B. HEWITT said that shamans among the Iroquois were all jugglers and had annual meetings at which they showed their skill. They believed that each trick came from a "dangerous dream." Each juggler was obliged at these meetings to show a new trick or he forfeited his life, and a simple trick answered the purpose if it deceived the other jugglers. Jugglers could swallow pebbles, knives, and the like, by the use of a tube inserted in the throat, made of a piece of *Angelica*. They also caused "appearances" in the smoke after putting tobacco and perfumes upon the fire. A juggler that could not tell the meaning of a dream also forfeited his life.

Mr. FRANCIS LA FLESCHE related some tricks played by the Pawnee jugglers. One feat, the swallowing of a deer's head, he could not explain. "Arrows" were swallowed which were made of a vine soaked and greased so as to render them pliable. Pawnee tricks were more remarkable than those described by the speaker of the evening, in that the jugglers were nearly nude, remained in the midst of the audience, and did not use any of the aids employed by professional prestidigitators. Medicine men sometimes avenged themselves by playing tricks that seemed simple enough when explained. One secretly tied a horse's hair tightly around the exposed tip of the tail of the offender's horse, causing the animal to walk backward in circles until restored to its normal condition by the medicine man on payment of a fee.

Mr. MOONEY spoke of remarkable hypnotic phenomena which he had observed among the Indians. He believed in the possibility of hypnotizing an entire audience of Indians, especially during the ghost dance,

when subjects become hysterical. After a Wichita dance he saw a subject who offered unusual resistance finally hypnotized. First, a black handkerchief was waved by the shaman before the eyes of the woman as she circled in the dance, then an eagle's feather. After a half hour's struggle, during which time she trembled as if in agony and at times braced herself to avoid falling, she finally fell rigid, as others had done. The speaker had seen ten or twenty persons stretched upon the ground in a hypnotic trance in the remarkable dramatic performance of the Hopi Indians.

Dr. E. L. MORGAN reported having seen an Indian shaman manipulate a man who had been shot in the chest, and produce by sleight-of-hand the bullet from his back. It is said that American Indians also perform a trick similar to the famous mango trick of India, making a bush grow in a few moments under a buffalo robe. Most spiritualistic phenomena are to be explained, he thought, as mind reading.

Dr. GUDMUND HATT, of the University of Copenhagen, said that much of Lapp magic also is explainable by hypnotism. Very susceptible persons can not only be strongly influenced, but cured from sickness, or made sick, or even killed, by the hypnotic influence exercised by Lapps. Many Scandinavians believe this, and there are well authenticated instances of it. Lapps also understand "second sight;" instead of a crystal, they use a glass of liquor. In one such instance a Lapp saw a favorite deer of his which was being treacherously killed in a distant place; the fact was afterwards confirmed.

Dr. JOHN R. SWANTON was elected President of the Society for the ensuing year; Dr. I. M. CASANOWICZ, Vice-President; and WILLIAM A. BABCOCK a member of the Board of Managers. The following officers were reëlected: *Secretary*, Dr. DANIEL FOLKMAR; *Treasurer*, Mr. J. N. B. HEWITT; *Councilors:* Mr. FRANCIS LA FLESCHE, Mr. GEORGE C. MAYNARD, Dr. EDWIN L. MORGAN, and Mr. FELIX NEUMANN.

DANIEL FOLKMAR, *Secretary.*